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A new crawfish of the genus *Distocambarus,* subgenus *Fitzcambarus* (Crustacea: Decapoda: Cambaridae) from South Carolina

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Abstract.—A new crawfish, *Distocambarus* (*Fitzcambarus*) *hunteri,* is described from an apparently limited distribution in the Saluda River basin of South Carolina, U.S.A. The new species is distinguished by a large bladelike central projection and a mesial process that extends about half the length of the central projection; the mesial margin of the palm in males is shorter than the width of that structure and the postannular sternite of females is subequal in length to the annulus ventralis. The closest relative to the new species seems to be *D.* (*F.*) *youngineri* Hobbs & Carlson.

In the lengthy paper containing the description of *Procambarus* (*Distocambarus*) *devexus,* later to become the first member of the genus *Distocambarus,* Hobbs (1981: 308–309) commented on the serendipitous discovery of the initial specimens. Despite 40 years of intense collecting in Georgia, he had never encountered the species and was "reasonably certain" that the first juveniles collected were members of *Cambarus* (*Depressicambarus*) *latimanus* (LeConte 1856). Subsequent collecting, particularly by Dr. Paul Carlson in South Carolina, demonstrated sufficient diversity prompting Hobbs & Carlson (1983) to elevate the subgenus *Distocambarus* to a generic rank, which Hobbs (1983) then divided into two subgenera. By 1985 when Carlson had moved from South Carolina and Hobbs' advancing age had curtailed his field activities, the number of known species had risen to four (Hobbs 1989; Hobbs & Carlson 1985). All members of the genus are primary burrowers of somewhat limited distributions, which probably explains why so few records existed for a genus that not only displays unexpected diversity but also occurs in two different watersheds (Saluda and Savannah) in Georgia and South Carolina.

In 1994 the second author collected several burrowing crawfishes as part of a study of the rare crawfish species of South Carolina. He sent them to the first author for identification, and among them was a fifth member of *Distocambarus.*

In the text that follows, the following abbreviations are used: TCL, total carapace length; PCL, postorbital carapace length; TU, Tulane University Museum of Natural History, Belle Chasse, LA; USNM, U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C.; UADC, University of Alabama Decapod Collections, Tuscaloosa, AL.

Distocambarus (*Fitzcambarus*) *hunteri,* new species
Fig. 1

Diagnosis.—Pigmented; eyes small, faceted. Rostrum subspatulate with tiny, beadlike acumen and lacking marginal spines. Carapace rarely with single cervical spine or tubercle on one or both sides, spine usually absent. Branchiostegal spines small but acute. Suborbital angle small to obtuse. Areola 37.1% to 47.9% (avg. 40.9%) of TCL, 43.5% to 54.1% (avg. 47.8%) of PCL; 10.5 to 14.8 (avg. 13.1) times longer than wide, with 1 or 2 punctations across narrowest part. Chela width less than length of mesial margin of palm, with row of 6 to 9 tubercles, flanked dorsolaterally by second row of 3 to 7 spiniform to squamiform tubercles; dactyl of Form I male about 1.3 times length of mesial of palm, and chela 68.8% to 74.5% (avg. 69.4%) of TCL; length of carpus greater than inner margin of palm. First pleopod of Form I male with small but distinct shoulder somewhat proximal to cephalic base of corneous, platelike, subquadrangular central projection, which projection oriented about 45° distolaterally to main axis of appendage; mesial process tapering from base to acute tip, noncorneous, extending distally about half distance of central projection; cephalic process only suggested by swelling near cephalomesial base of central projection; distal third of appendage inclined caudad; proximomesial base of pleopod usually with tiny spur.

Annulus ventralis of female with cephalomedian margin membraneous, allowing hingelike motion; annulus much elevated (ventrally) except for cephalomedian excavation; sinus originating near midline in cephalic third, then transcribing gentle arc to be lost just before reaching caudal margin. Postannular sclerite subtriangular, and subequal in length to annulus; first pleopods represented by tubercles at best. (Measurements of type specimens in Table 1.)

Description of holotypic male, form I.—Cephalothorax (Fig. 1*b, f*) subovate, compressed laterally; maximum width of carapace 1.1 times height at caudodorsal margin of cervical groove; abdomen slightly narrower than carapace. Areola 13.1 times longer than wide with only one punctation in narrowest part. Cephalic section of carapace 1.6 times length of areola, latter constituting 38.3% of TCL (46.7% of PCL). Carapace mostly punctate, except sparse granulose tuberculations in extreme cephalolateral region. Rostrum broadly spatulate, with apex produced into tiny, tuberculate acumen reaching distal margin of ultimate podomere of antennular peduncle; rostrum moderately depressed. Subrostral ridge moderately developed and evident in dorsal aspect to near midlength of rostrum. Suborbital angle obtuse but evident; branchiostegal spine small but acute. Fifth abdominal pleuron gently rounded distally with no evidence of acute caudo- or cephaloventral angles. Telson with single fixed acute spine in each caudolateral corner of cephalic portion. Epistome (Fig. 1*k*) with cephalic lobe broadly subtriangular, about as wide as long, with small cephalomedian projection; margins of lobe slightly elevated (ventrally)

Table 1.—Measurements (mm) of type specimens of *Distocambarus* (*Fitzcambarus*) *hunteri*, new species. The asterisk (*) indicates an estimation; left branchiostegite broken.

	Holotype	Allotype	Morphotype
Carapace			
Height	11.5	11.4	12.5
Width	12.4	12.1	13.0*
Entire length	27.4	25.9	27.6
Postorbital length	22.5	22.0	23.9
Areola			
Width	0.8	0.8	0.9
Length	10.5	10.4	10.4
Rostrum			
Width	7.5	6.1	6.3
Length	5.2	5.3	5.1
Chela			
Length of mesial margin of palm	7.9	5.7	7.0
Width of palm	6.9	6.0	6.5
Length of lateral margin	18.3	14.0	16.3
Length of dactyl	9.9	8.6	9.1
Carpus of cheliped			
Width	4.7	5.8	5.6
Length	8.9	7.1	7.3
Abdomen			
Width	10.4	11.2	10.2
Length	21.2	22.3	22.9

and obtuse submedian longitudinal fovea at caudal union of lobe with main body; epistomal zygoma broadly arched. Antennular peduncle lacking spine on ventral surface of proximal podomere; antennal peduncle with spine on ventral surface of basal podomere reduced to tubercle; tip of flagellum reaching nearly to caudal margin of carapace. Antennal scale (Fig. 1*g*) about 1.5 times longer than wide, widest slightly distal to midlength, lateral portion thickened and ending distally in small but stout spine; greatest width of lamellar area 1.8 times width of thickened lateral area.

Third maxilliped with palpus, when extended, reaching nearly to distal margin of antennal peduncle; ventromesial surface of ischium with dense mat of long stiff setae occurring in tufts, which mat completely obscuring dentate opposable margin.

Right chela (Fig. 1*i*) subelliptical in section, strongly depressed, palm somewhat narrower than length of mesial margin of palm; length of latter 44.5% of total length of chela; most of palm studded with squamous and subsquamous tubercles; mesial margin of palm with row of 8 tubercles, flanked dorsally by less developed row of 5 tubercles. Both fingers with well defined dorsomedian ridges flanked by setiferous punctations. Opposable margin of fixed finger with row of 4 subequal tubercles along proximal third of finger and single row of minute denticles lying between tubercles and reaching to base of corneous tip of finger; additional prominent tubercle ventral to denticle row just distal to midlength of finger; lateral margin weakly costate. Opposable margin of dactyl with 2 large tubercles in proximal third, distalmost distinctly larger, with single row of minute denticles extending from tubercles to base of corneous tip of finger; mesial margin with 2 weak squamous tubercles in basal portion, followed by indistinct row of setiferous punctations; setae of ventrolateral punctations of margin not conspicuously long or stiff.

Carpus of cheliped 1.1 times length of inner margin of palm; dorsal surface sparsely punctate, with slightly sinuous sulcus; mesial surface with 4 subacute spiniform tubercles in proximal half, flanked dorsally by 3, more rounded, tubercles; ventral margin with stout subspiniform distolateral tubercle, and weak squamous tubercles in mesial corner, lateral one articulating with condyle on propodus.

Merus with small dorsodistal subspiniform tubercle and tuberculate ventral margins, lateral row of 9 irregular tubercles and mesial row of 12, tubercles of both rows increasing in size distally. Ischium with row of 5 tubercles along mesial margin; sufflamen absent.

Chela of second pereiopod with conspicuous row of long stiff setae on lateral and mesial margins; carpus with similar row on mesial margin, lateral margin with few long setae; merus with only single tuft of about 10 long setae situated on dorsomedian margin. Hook on ischium of third pereiopod (Fig. 1*l*) stout but simple, slightly overreaching basioischial articulation and not opposed by strong tubercle on basis. Coxae of all pereiopods except first with conspicuous tufts of plumose setae masking sternal and coxal features; small rounded caudomesial eminence on fourth periopodal coxa.

First pleopods (Figs. 1*a, c, b*) symmetrical, bases not contiguous, tips reaching coxae of third pereiopods when abdomen flexed; prominent caudoproximal and proximomesial lobes present; pleopods flexed slightly distal to midlength and lacking subapical setae. Terminal elements as in "Diagnosis."

Mesial lobe of proximal podomere of uropod bearing acute spine, spine lacking on lateral lobe; mesial ramus with distomedian spine, spine small and not reaching distal margin.

Description of allotypic female.—Except for secondary sexual characters, differing from holotype in following respects: Branchiostegal spine more prominent; areola with 2 punctations in narrowest part; tuberculations of upper surface of chela more

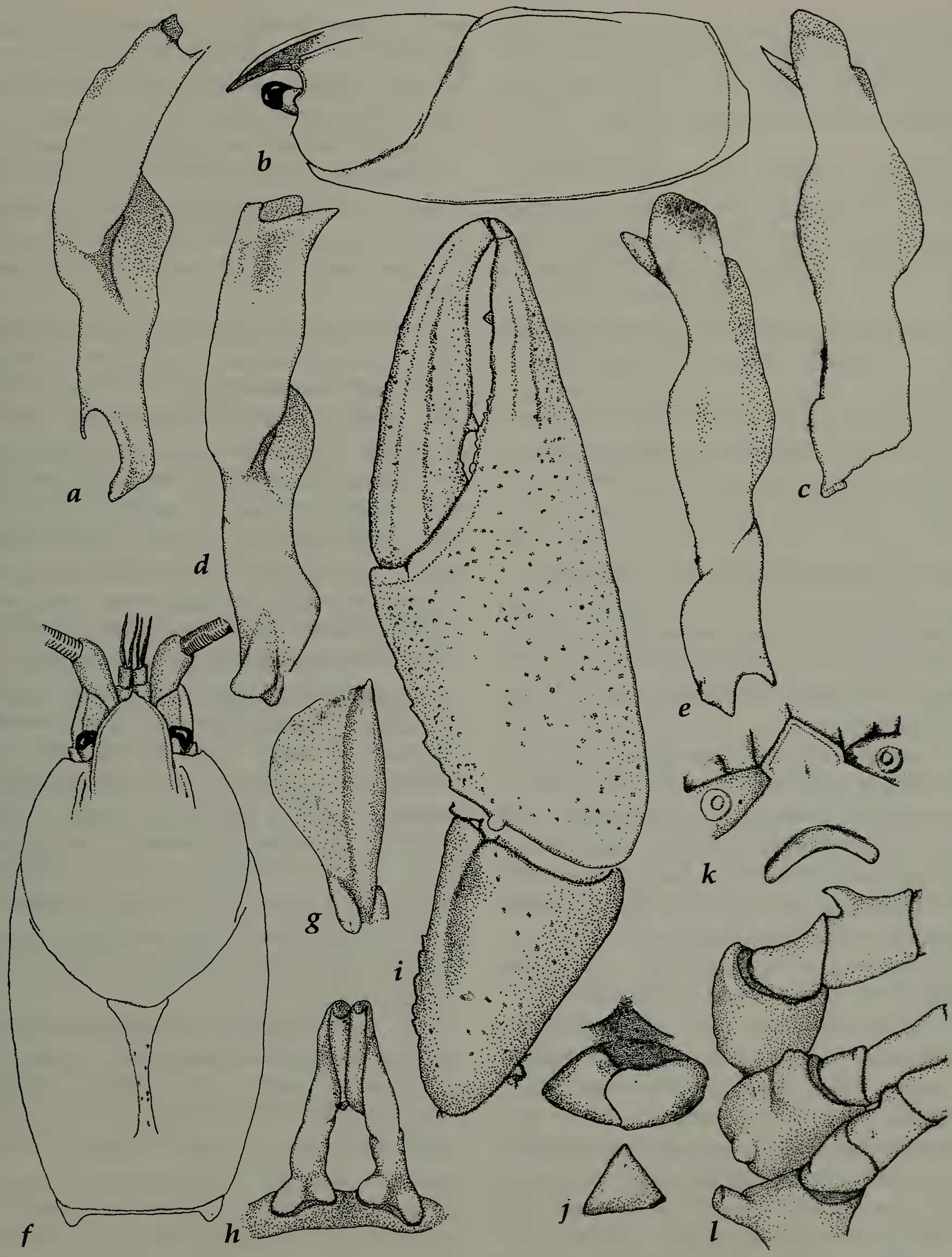

Fig. 1. *Distocambarus* (*F.*) *hunteri,* new species (all from holotypic male, Form I, except *d, e* from morphotypic male, Form II, and j from allotypic female): *a, d,* Mesial aspect of first pleopod; *b,* Lateral aspect of carapace; *c, e,* Lateral aspect of first pleopod; *f,* Dorsal aspect of carapace; *g,* Antennal scale; *h,* Caudal aspect of first pleopods; *i,* Dorsal aspect of distal podomeres of cheliped; *j,* Annulus ventralis and adjacent sternites; *k,* Epistome; *l,* Ventral aspect of proximal podomeres of left third through fifth pereiopods.

sparse. Sternal sclerites of third and fourth pereiopodal segments broadly excavate and densely setose laterally; setae of coxa and sternite of second segment shorter and less dense.

Annulus ventralis (Fig. 1*j*) broadly excavate cephalically and movable through arc of about 15 to 20°; 1.8 times wider than long; sinus arising in fossa. Postannular sclerite about 40% width of annulus; cephalic portion somewhat overreaching sternite of antecedent segment. First pleopods absent.

Description of morphotypic male, form II.—Except in secondary sexual characters, differing from holotype in following respects: Areola with 2 punctations in narrowest part; mesial margin of palm with row of 5 tubercles, flanked dorsally by second row of 5; both lobes of proximal podomere of uropod with acute spine, that of lateral lobe tiny; tuberculation of upper surface of chela intermediate between holotype and allotype.

Hook on ischium of third pereiopod represented by large but low tubercle and not overreaching more proximal segment. First pleopods (Figs. 1*d, e*) with incomplete juvenile suture delineating basal part; terminal elements much more blunt than those of form I male and noncorneous.

Color notes.—Ground color varies from lighter brown in recently molted individuals to darker brown in older intermolt ones. Staining from burrow soils and groundwater apparently masks exoskeleton colors. Cephalic sections of carapace more uniformly brown and less mottled than thoracic sections; mottling fading to reddish brown posteriorly in cephalic section and ventrally in thoracic section. Ground color of abdomen lighter than that of carapace; terga with paired, almost black, elongate spots, which become smaller and less obvious caudally; pleura with similarly colored markings giving appearance of stripe above lighter brown lateral margins; telson and uropods lacking distinct markings, and of lighter color than other abdominal segments. Distal portion of merus and carpus of cheliped ash brown and bearing dark brown tubercles; dorsal surface of palmar area of propodus paler brown; fingers of chela with reddish brown to red finger tips; movable finger darker of the two. Remaining pereiopods bluish to ash brown with more flesh-colored bases. Ventral surface of abdomen and pleopods brown to flesh-colored.

Specimens held in laboratory and fed artificial formulated diet retain the mottled appearance and abdominal markings. However, ground color of these animals has a distinctly blue hue, blue replaces brown in the chelipeds, and other pereiopods are pale blue. Ventral surfaces of the pereiopods are tan to bluish cream and the ventral abdomen is a pale blue. These observations are compatible with the suggestions put forth by Fitzpatrick (1987) concerning the effect of diet, and perhaps light, on coloration.

Disposition of types.—The holotypic male, Form I, the allotypic female, and the morphotypic male, Form II are in the collections of the National Museum of Natural History, USNM (282786, 282787, and 282788, respectively); paratypic series are in the Tulane Museum of Natural History (TU 6746, 1 ♂I, 1 ♀, 1 ♂imm; TU 6747, 2 ♀, 2 ♀imm) and the University of Alabama (UADC 450.01, 1 ♂II, 1 ♀; UADC 451.01, 1 ♂I, 1 ♀).

Type locality.—Burrows in runoff drainage just west of State Route 391 at junction of State Route 194; 34°05′26.8″N, 81°34′88.1″W; Saluda River drainage, Saluda Co., South Carolina. Here the sandy substrate was wet (water table <15 cm) from recent rains, but numerous chimneys were evident among the thick mat of roots from associated vegetation. Except for one female that was associated with recently released young, each burrow was occupied by a single animal, and the creatures were actively moving in the burrow. The overstory was composed of loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), willow oak (*Quercus phellos*), and American elm (*Ul-*

mus americana); the midstory was red maple and dogwood (*Cornus florida*); and the understory was red oak seedlings (*Q. falcata*), sumac (*Rhus glabra*), honeysuckle (*Lonicera* sp.), smilax (*Smilax* sp.), American holly (*Ilex americana*), and grapevine (*Vitis* sp.). At the type locality, one specimen of *Cambarus* (*Depressicambarus*) *latimanus* was collected from a burrow.

Range and specimens examined.—This species seems to be confined to a very limited portion of the Saluda drainage in Saluda County, South Carolina. This is not wholly surprising. It closest relative, *Distocambarus* (*Fitzcambarus*) *youngineri* Hobbs & Carlson 1985, likewise has a very limited distribution, being confined to Newberry County, just north of the Saluda River (Hobbs & Carlson 1985, Eversole 1995). The other members of the genus all have limited distributions. During the course of this study, the second author conducted extensive searches throughout the upper portions of the several drainages associated with the southern part of the state and no other collections of this species were found. Several other burrowing species, including other *Distocambarus* spp. were recorded, however.

Fourteen specimens from the type locality have been studied (counts below), plus four juveniles kept alive in the laboratory for collection of maturation data. The second site produced two adults.

Saluda County, South Carolina: (1) type locality, 1 ♂II, 1 ♀, 24 Sep 1994, A. G. Eversole, C. D. Baumann, colls.; 1 ♂II, 1 ♀, 1 ♂imm, 2 ♀imm, 18 Oct 1995, A. G. Eversole et al., colls.; 2 ♂I, 3 ♀, 1 ♂imm, 1 ♀imm, 20 Nov 1995, A. G. Eversole et al., colls.; (2) burrows on W side of Wyses Ferry Rd, about 0.6 mi N of St Rte 194, 1 ♂I, 1 ♀, 4 Oct 1994, C. J. Kempton and C. D. Baumann, colls.

Variations.—The small sample, almost all from the same locality, gave little information on variation beyond that encompassed by the descriptions of the primary types. Most conspicuous, as is usual, was the varying numbers and types of tuberculation associated with the podomeres of the pereiopods; additional collections from other sites may indicate a wider range of expression of other characters.

Size and life history notes.—The largest specimen was a form I male of 29.4 mm TCL (25.6 mm PCL); the smallest mature animal, a female, was 18.0 TCL (14.0 mm PCL). No ovigerous females or females bearing young were collected, although a female collected on 18 October 1995 and another on 20 November 1995 each had recently released young in its burrow, the only recorded instances, save one noted below, of an adult animal sharing its burrow. Form I males were collected in October and November.

Ecological notes.—*Distocambarus* (*Fitzcambarus*) *hunteri* is a primary burrower and as characteristic of other members of the genus, the burrows extend to the water table. Under some circumstances, vertical shafts of the burrows may reach more than a meter in depth and the main burrow may have an array of side shafts connecting with the surface at capped openings. Many of the burrow shafts were adjacent to tree and shrub roots, making excavation difficult. Freshly capped burrows appeared as if the crawfish individually stacked uniformly made balls (approximately 5 to 6 mm diam) of excavation material into a chimney shaped mound. The chimneys reached 10 mm in height in some cases, but both the architecture and chimney height were subject to weathering. Although weathered chimneys appeared as only a clod of excavated soil, their different color was noticeable against the forest floor. The species seems to be a solitary animal because on only one occasion (Oct) was more than one adult (1 ♂I, 1 ♀) excavated from a burrow. On two occasions, however, a female was collected from a burrow that contained free-ranging juveniles, eight in one burrow and six in the other. Unfortunately, all of our collections come from September through November, and it is not possible to say that recruitment occurs solely in the fall of the year. The exoskeleton on the specimen collected on 10 October 1995 appeared soft, a sign that crawfish were rapidly growing and molting at that time of year. The preferred habitat seems to be a mixed pine-hardwood woodland, with a comparatively high water table.

Relationships.—This crawfish is most closely related to *D.* (*F.*) *youngineri,* the nearest populations of which occur about 9.5 airmi (15.3 air km) northwest of the sites where *D. hunteri* is found. The pleopods of the Form I males are quite similar, both having a large subquadrangular central projection that is bladelike and oriented somewhat oblique to the cephalocaudal axis of the appendage. In *D. hunteri,* the central projection is disposed mesially almost 45° to this axis, whereas in *D. youngineri* it is disposed about 30°. The cephalic process of *D. hunteri* is scarcely recognizable, but is usually visible, albeit as a vestigial structure, in *D. youngineri.* The mesial process of the new species extends only half as far distally as does the central projection, while in *D. youngineri* the process extends at least two-thirds as far. The areola of *D. hunteri* is wider and, accordingly, frequently has an extra punctation in its narrowest part. In *D. hunteri* the areola is 10.5 to 14.8 (avg. 13.1) times longer than wide and it constitutes 37.1% to 47.9% (avg. 40.9%) of TCL. The comparable numbers in *D. youngineri* are 13.0 to 24.0 (avg. 17.6) and 37.6% to 41.9% (avg. 38.9%) of TCL. The branchiostegal spine, usually absent or extremely obtuse in *D. youngineri,* is small but evident in *D. hunteri.* In Form I males of the latter, the second tubercle of the opposable margin of the dactyl is distinctly larger than the more proximal one, and the mesial margin of the palm is longer than the palm is wide. In *D. youngineri,* the primary tubercles of the opposable margin of the dactyl are subequal in size, and the mesial margin of the palm is shorter than the palm width. The ventral surface of the ischium of the third maxilliped of *D. hunteri* is provided with so dense a mat of long stiff setae that the denticulate opposable margin is completely obscured. In the female, the cephalomedian margin of the annulus ventralis is less deeply and widely excavate, and a less extensive membranous area permits a movement through an arc of 15° to 20°, as opposed to 30° to 45° in *D. youngineri.* In the new species, too, the sternite between the fourth pereiopods is broadly excavate, rather than having a fissure-like configuration. Females of *D. hunteri* can also be distinguished by the much longer postannular sclerite that is subequal in length to the annulus and is subtriangular in outline. The large, bladelike central projection of the first pleopod of the first form male, coupled with the comparative length of the mesial process, will serve to separate *D. hunteri* from the other members of the genus. Several features of the new species (e.g., the ratio of palm width to mesial margin length, areola width, and postannular sclerite of females) may require a redefinition of the subgenus, but we deem it prudent to defer such until more specimens of the several species are available to permit a greater appreciation of the limits and extent of variation.

Etymology.—This crawfish is named in honor of Dr. W. D. Russell-Hunter, formerly of the Department of Biology, Syracuse University, Syracuse, New York, and the Marine Biology Laboratory, Woods Hole, Massachusetts, for his friendship, support and guidance during the formative years of the second author's education. We are pleased to propose this taxon honoring Dr. Russell-Hunter for all his contributions to invertebrate zoology.

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